Notes on Insect Pollination of Two Species of *Eucalyptus* (Myrtaceae) From South-west Western Australia

BY T. J. HAWKESWOOD*

Abstract

Jewel beetles (Buprestidae) and flower chafers (Scarabaeidae) are recorded as pollinators of *Eucalyptus foecunda* Schau. and *E. cylindriflora* Maiden et Blakely (Myrtaceae) in the south-west mallee region of south-west Western Australia. Observations were undertaken in February, 1980.

Introduction

The following field observations on insects (mainly beetles) visiting the flowers of *Eucalyptus foecunda* Schau. and *E. cylindriflora* Maiden et Blakely, between Lake King (33°05'S, 119°40'E) and Peak Charles (32°23'S, 121°10'E) (Figs. 1 and 2) were made on 3 February, 1980. Flowering of both species was sporadic between these two localities. Apart from a few plants of *Melaleuca pauperiflora* F. Muell. (Myrtaceae) (which were poorly flowering) and the twiner, *Billardiera bicolor* (Putterl.) Bennett var. *bicolor* (Pittosporaceae) (which was profusely flowering), no other species of plant were in flower in the areas investigated. The weather conditions during the day were clear with little or no cloud and temperatures varied between 27°C to 30°C.

Eucalyptus foecunda Schau. (Narrow-leaved Red Mallee)

This species is usually a many-stemmed mallee growing from 2.0-4.5 m high or occasionally may be a tree to 8m high (Chippendale, 1973). The bark is smooth, grey and deciduous. The lower part of the trunks often possesses an accumulation of bark which is decorticated into ribbons. The glossy, light green, mature leaves are alternate, linear-lanceolate with a short, acuminate point, glandular, usually 4-7 cm long, 0.4-1.0 cm wide. The flowers (i.e. stamens) are cream, and there are up to 11 flowers/umbellate inflorescence. Chippendale (1973) states that the species flowers during December to March and is found in most of southern Western Australia and in the mallee dune areas of northern South Australia, north-western Victoria and the southern part of western New South Wales. According to Chippendale (1973) this eucalypt occurs in sand (which may be derived from lateritic parent material), or in sandy loam, and is sometimes found in areas near salt lakes.

Eucalyptus cylindriflora Maiden et Blakely (White Mallee)

This species is usually a slender, spreading mallee growing from 2.4-4.5 m high with usually smooth, white or grey bark shedding in ribbons. The shining, dark green, mature leaves are alternate, linear-lanceolate to narrowly oblanceolate or sometimes falcate and measure 5-7 cm long and 5-9 mm wide. The flowers (i.e. stamens) are creamy-yellow to white and there are up to 7 flowers/umbellate inflorescence. Chippendale (1973) states the species flowers during January to March. Chippendale (1973) also records the species from Bendering, southward to the Lake Grace and Lake King area, eastward to Balladonia (east of Peak Charles) and notes that it occurs on sandy loam in mallee scrub, sometimes in association with *Melaleuca uncinata* and *Eucalyptus oleosa* (both Myrtaceae).

Observations

1. 32 km E of Lake King (33°00'S, 120°02'E) (Fig. 1). 930 hrs (WST). Several flowering plants of *E. foecunda* were examined by the roadside. The only insect visitors to the flowers were numerous individuals of the large brown cetonid *Diaphonia* (*Hemichnoodes*) *mniszechii* (Janson) (Scarabaeidae) (Table 1). These beetles were actively

* Department of Botany, James Cook University, Townsville, 4810.

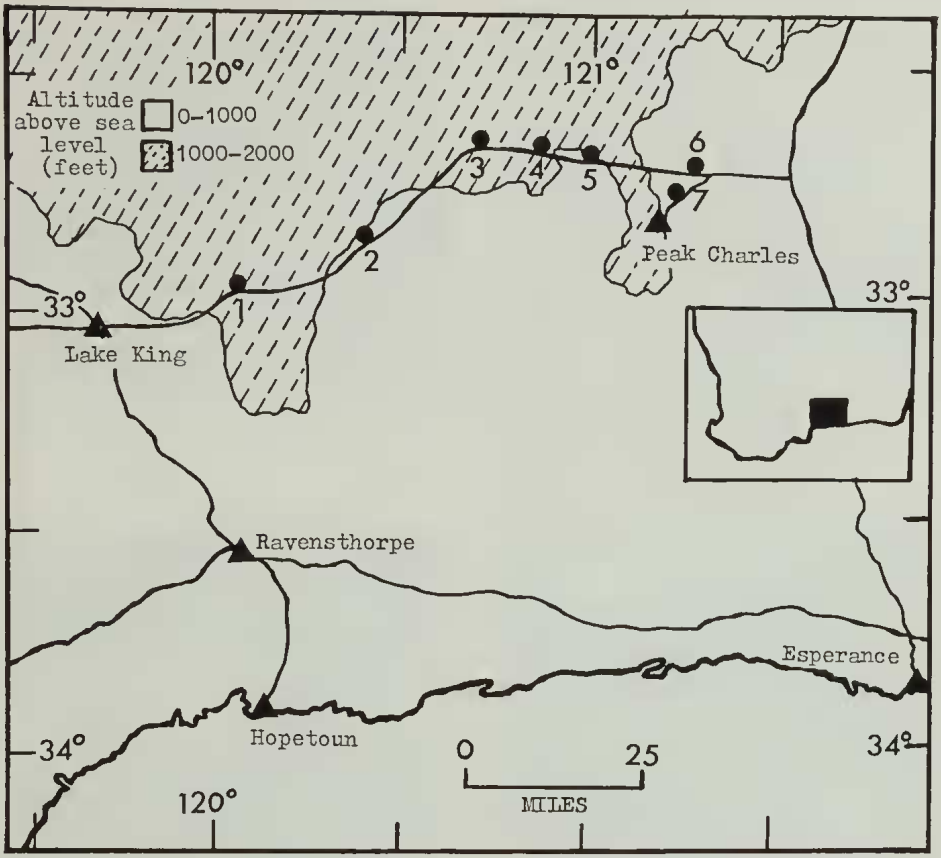

Fig. 1. Map showing the route taken on 3 February 1980, between Lake King and Peak Charles, Western Australia. (Numbered dots indicate stops at which observations were undertaken. Inset shows the area in relation to the remaining portion of south-west Western Australia).

feeding on nectar and pollen and flying around the eucalypts. Examination of several individuals revealed large amounts of yellow pollen attached to the head, pronotum and on the hairy, posterior undersurface of the abdomen. (*Diaphonia mniszechii* measures 2-3 cm long and the whole undersurface of the body is covered in long, brown to buff hairs. It is most likely that pollen is largely transported by these hairs from flower to flower during feeding and as the beetles move over the flowers).

2. 72 km E of Lake King (32°52'S,

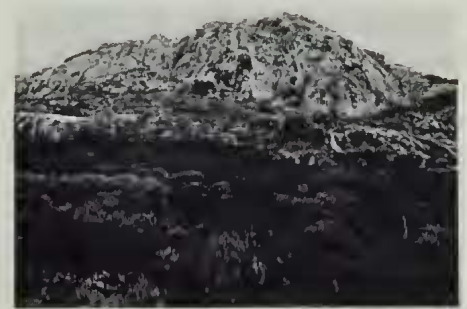

Fig. 2. Peak Charles, showing surrounding low vegetation consisting mainly of *Eucalyptus, Acacia* and *Casuarina*. (Photograph by T. Helder).

Table 1. List and occurrence of the insect visitors to Eucalyptus foecunda Schau. and E. cylindriflora Maiden at Blakely, between Lake King and Peak Charles (Feb. 1980). (Numbers refer to sites shown in Fig. 1. and listed in the text).

Species	Sites	1	2	3	4	5	6	7
Coleoptera								
Scarabaeidae								
Diaphonia (Hemichnoodes) mniszechii (Janson)		•	•		•	•	•	•
Metallesthes metallescens White			•	•	•	•	•	•
Buprestidae								
Stigmodera (Themognatha) tibialis Waterhouse					•			
Stigmodera (Themognatha) mniszechi Saunders					•			•
Stigmodera (Themognatha) chevrolati Gehin.					•			•
Stigmodera (Themognatha) murrayi Gem. & Har.								•
Stigmodera (Themognatha) brucki Thomson								•
Stigmodera (Themognatha) chalcodera Thomson								•
Stigmodera (Castiarina) murtolamajor Thomson							•	
Cleridae								
Eleale aulicordes Gorh.							•	
Hymenoptera								
Scoliidae								
Campsomeris anthracina Burn.							•	

120°25'E) (Fig. 1). 1025 hrs. Fifteen plants of *E. cylindriflora* were examined adjacent to the road and into nearby vegetation. Large numbers of *D. mniszechii* were present as was the black cetonid beetle *Metallesthes metallescens* White (Scarabaeidae). No other insects were observed on the flowers (Table 1). Individuals of both species carried a dusting of pollen on the head, pronotum and on the posterior undersurface of the body including the legs.

3. About 98 km E of Lake King (32°40'S, 120°40'E) (Fig. 1). c. 1100 hrs. One small flowering plant (2m high, the only one flowering in the immediate area) of *E. foecunda* was examined. Large numbers (c. 40-60) of *M. metallescens* were observed actively feeding on nectar and flying around the mallee bush. No *H. mniszechii* were seen (Table 1).

4. About 16 km E of 90 mile water tanks, towards Peak Charles (32°42'S, 120°50'E) (Fig. 1). 1120 hrs. Five plants of *E. cylindriflora* growing by the roadside were examined for insect visitors. Both the scarabs *D. mniszechii* and *M. metallescens* were present, as well as a small number of the jewel beetles *Stigmodera* (*Themognatha*) *tibialis* Waterhouse (Fig. 3), *S. (T.) mniszechi* Saunders (Fig. 4) and *S. (T.) chevrolati* Gehin (Buprestidae) (Table 1). Of the three buprestid species observed, *S. chevrolati* was the most common. (Examination of randomly sampled beetles of all species revealed that *S. chevrolati* carried the largest pollen loads of the three, mostly on the head, pronotum and undersurface of the body).

5. 32 km E of 90 mile water tanks, towards Peak Charles (32°43'S, 121°00'E) (Fig. 1). 1230 hrs. Three plants of *E. foecunda* were flowering which attracted only the two species of Scarabaeidae in large numbers (i.e. c. 50-100 beetles/plant). No buprestids were observed (Table 1).

6. 51.2 km E of 90 mile water tanks, north

Fig. 3. *Stigmodera (Themognatha) tibialis* Waterhouse on flowers of *Eucalyptus*. Bar indicates 20 mm. (Photograph by T. Helder).

Fig. 4. *Stigmodera (Themognatha) mniszechi* Saunders on flowers of *Eucalyptus*. Bar indicates 20 mm. (Photograph by M. Peterson).

Fig. 5. *Stigmodera (Themognatha) murrayi* Gem. & Har. on flowers of *Eucalyptus*. Bar indicates 15 mm. (Photograph by D. Knowles).

Fig. 6. *Stigmodera (Themognatha) heros* Gehin on leaves of *Eucalyptus*. Bar indicates 20 mm. (Photograph by M. Peterson).

of Peak Charles (32°44'S, 121°15'E) (c. 2 km W of t/off to Peak Charles) (Fig. 1). 1255 hrs. One plant of *E. cylindriflora* was examined. *Diaphonia mniszechii* and *M. metallescens* were present on the flowers, the former species being more common. About 20 specimens of the small green clerid beetle *Eleale aulicordes* Gorh. (Cleridae) were active on the flowers (Table 1). Two specimens of the black wasp *Campsomeris anthracina* Burn. (Scoliidae) were additional visitors (Table 1). One jewel beetle *Stigmodera* (*Castiarina*) *mustclamajor* Thomson was resting on one of the flowers as well, but was not very active (Table 1).

7. 5 km NE of Peak Charles (32°50'S, 121°11'E) (Fig. 1). 1550 hrs. Thirty-five plants (2-3 m high) of *E. foecunda* were examined. On almost every plant, the following beetles were common: *D. mniszechii*, *M. metallescens*, *S. mniszechi*, *S. murrayi* Gem & Har. (Fig. 5), *S. brucki* Thomson, *S. chalcodera* Thomson (Table 1). Of these *S. mniszechi* and *S. chalcodera* were the least common.

Discussion

(a) General comments on the pollination of the two *Eucalyptus* species.

It appears from my observations, that the large searab and buprestid beetles (body length 2.5-5.0 cm) are the main pollinators of *E. foecunda* and *E. cylindriflora* in the areas and at the times investigated. Of the two beetle

groups, it is probable that the scarabs, as a whole, are more effective pollinators since they were present in greater numbers than the buprestids, spent more time feeding on nectar and moving over individual flowers than in flight, and carried larger amounts of pollen. The hairy undersurface of their bodies (in contrast to the ± glabrous body surfaces of the buprestids), facilitates better attachment and transport of pollen which may be deposited on stigmas of flowers during feeding. In addition, pollen from the head would be deposited efficiently on the eucalypt stigma during feeding when a beetle places its head down into a flower to feed on the nectar. A high level of cross-pollination is probably effected in many areas (where more than one tree is flowering), by the scarabs, since they are strong fliers and individuals were observed actively flying from tree to tree, especially at the last observation site (7) near Peak Charles (Fig. 1).

It is doubtful whether the small clerid beetle *Eleale aulicordes* effects pollination of the eucalypts. Due to their small size (7-8 mm long) and their nervous activity, they are unlikely to contact the stigma of the eucalypt flower in order to facilitate pollen transfer from their bodies. Observations indicated that they were mainly pollen feeders.

The large, black wasp *Campsomeris anthracina* (body length 2.5-3.0 cm), spent up to thirty seconds feeding from a single flower and in so doing, collected pollen grains onto the body. Wasps are efficient pollinators but probably play a small part in *Eucalyptus* pollination in this portion of south-west Western Australia, in comparison to the role played by scarabs and buprestids.

(b) Flower-chafers (or cock-chafers or scarabs) (Scarabaeidae) as pollinators.

Little has been recorded on pollination by Australian Scarabaeidae (especially of the anthophilous subfamilies Cetoniinae and Melolonthinae). General text-books on Australian insects (e.g. Froggatt, 1907; Carter, 1933; McKeown, 1945; Britton, 1970) state that many insect species (including scarabs) visit flowers for food in the adult stage, but they do not usually mention the role of these insects in pollination. Australia has probably 300-500 species of anthophilous Scarabaeidae, but most of them have been little studied, both taxonomically and ecologically. In a recent review on pollination of Australia plants, Armstrong (1979) notes that some members of the Melolonthinae are "specifically adapted to feed on nectar and pollen", while the Cetoniinae and Valginae are diurnal and "exclusively anthophilous".

Alderson (1976) noted that *Eupoecila australasiae* (Donovan) and *Diaphonia dorsalis* (Donovan) (both Cetoniinae) were anthophilous; the former species was noted as a visitor to flowers of *Xanthorrhoea australis* (Xanthorrhoeaceae), *Bursaria spinosa* (Pittosporaceae), *Leptospermum juniperinum*, *Angophora* and *Eucalyptus* species (Myrtaceae), while the latter was recorded on *Eucalyptus* species only. Hawkeswood (1981a) first examined pollen loads of four species of Scarabaeidae *Eupoecila australasiae* (Donovan), *Polystigma punctata* (Donovan), *Glycyphana stolata* (Fabricius) (Cetoniinae) and *Phyllotocus macleayi* (Fischer) (Melolonthinae) on *Angophora woodsiana* Bail. (Myrtaceae) in south-east Queensland and on the basis of behaviour and pollen loads, came to the conclusion that they were important pollinators of their food plant.

Likewise, *Metallesthes metallescens* and *Diaphonia mniszechii* appear to be important in pollination. However, further observations on their general biology, distribution and food plant preferences are needed.

(c) Jewel beetles (Buprestidae) as pollinators.

It is well known amongst many amateur and professional entomologists interested in the Buprestidae, that many species frequent flowers in the adult stage. However, little has been documented on their food plants, both in Australia and overseas. H. J. Carter (1933, and other papers), the first resident Australian authority on the family, recorded many buprestids from flowers of *Leptospermum* species (Myrtaceae) and other plants, but he did not undertake any systematic study of the food plants since he was preoccupied with the alpha taxonomy of the group, both at the specific and generic levels. Almost nothing was recorded on adult food plants of Australian buprestids until McMillan (1952) listed adult food plants of four species of *Stigmodera* (subgenus *Stigmodera*) from Western Australia. In a report on the flora and fauna of an arid area of Western Australia (at Queen Victoria Spring, c. 40 miles north of Zanthus, 30°25'S, 123°34'E), Slater and Lindgren (1955) listed 14 sympatric species of Buprestidae feeding on flowers of *Eucalyptus uncinata.** Hawkeswood (1981b) recorded various species of Buprestidae from flowers of the Western Australian Christmas tree, *Nuytsia floribunda* (Loranthaceae). Also recently, Williams (1977) and Hawkeswood (1978, 1981c, 1981d) have listed numerous food plants of adult beetles in eastern Australia. Despite the data available on adult food plants, no studies have as yet been undertaken in Australia (or elsewhere) in order to examine pollen loads using microscopic techniques.

* It would appear that from my examination of specimens of *E. uncinata* in the Western Australian Herbarium during 1980, and the distribution and notes provided by Chippendale (1973) that this eucalypt does not occur in the Queen Victoria Spring area, and thus the species from there was misidentified. The most likely *Eucalyptus* in the area is the Black Marlock (*E. redunca* Schau.), a common species in south-west Western Australia (Chippendale, 1973).

The author of this paper was unable to microscopically examine pollen from the beetles observed in the field and to compare it with pollen from anthers of the food plants, during the field trip from Lake King to Peak Charles. However, all available evidence (e.g. (a) the observation that the jewel beetles were not visiting any other plants for food at the time and (b) jewel beetles were on the open flowers of the eucalypts frequently contacting the anthers and stigmas) does suggest that the fine dustings of yellow pollen on many of the beetles examined, were that of the *Eucalyptus* species. Since further observations and microscopic examination of pollen loads of anthophilous beetles in south-west Western Australia (and elsewhere) are clearly needed, these notes are provided here in the hope they are a basis for further research on insect/plant relationships.

(d) Notes on diversity of jewel beetles (Buprestidae) on *Eucalyptus* flowers.

Perhaps the most interesting observation recorded on the trip was the diversity of buprestid species and their abundance. Of the 10 species of beetles recorded, 7 species belonged to Buprestidae, while only 2 belonged to Scarabaeidae and a single species to Cleridae (Table 1).

Hawkeswood (1980) recorded the large jewel beetle, *Stigmodera (Themognatha) heros* Gehin (Fig. 6) as a pollinator of *Melaleuca pauperiflora* F. Muell. (Myrtaceae) and suggested that jewel beetles dominate the feeding niche (i.e. both in species and individuals) on many flowering myrtaceous plants through the low rainfall ($\leq$ 20 inches ($\leq$ 50cm)) areas of southern Australia. In contrast, this niche appears to be shared more equally with insects such as lycid beetles (Lycidae), click beetles (Elateridae), longicorn beetles (Cerambycidae), flies (e.g. Tachinidae), and native bees, wasps and butterflies in the montane areas of eastern Australia (see

Hawkeswood, 1978, p. 271, for a list of species belonging to many of the insect groups noted above, on *Leptospermum flavescens* Sm.). The suggestion that buprestids can be dominant members of the feeding niche on Myrtaceae in south Western Australia is supported by the observations of Slater and Lindgren (1955) and Hawkeswood (this paper).

(e) *Eucalyptus* and pollination.

Pryor (1976) has provided a brief but concise account of our present understanding of the breeding system of *Eucalyptus*. He notes (1976, p. 25) that the *Eucalyptus* flower is highly constant in morphology throughout the genus. (The typical *Eucalyptus* flower is characterized by (a) the presence of an operculum (formed from the fusion of perianth segments), a cap covering the reproductive structures, which falls away at anthesis, exposing the numerous, free stamens arranged in two or more whorls, and (b) a thick style with a large, prominent stigma). At anthesis, the operculum falls from the flower, the stamens expand, and the anthers dehisce (usually within 24 hours; Pryor, 1951), exposing pollen (in most species) in "irregular granular aggregates on the surface of the anther" (Pryor, 1976). Pryor (1976, p. 25) also notes that the stigma at this stage is neither expanded nor receptive to pollen, although the pollen is mature and is able to germinate if placed on a receptive stigma. Pryor (1951) noted that the stigma was usually not receptive until several days after operculum fall and then remained receptive for up to four or five days and sometimes up to 10 days in the species he examined. Thus it has been concluded that *Eucalyptus* flowers are usually protandrous (Pryor, Chattaway and Kloot, 1956; Pryor, 1951, 1976) and that "The stigma usually becomes receptive on one or more days after the stamens are fully expanded, by which time much of the pollen is already removed from the anthers by visiting insects". (Pryor, 1976, p. 25). Pryor (1976, p. 25) also stated that pollination of almost all the species is effected by animal vectors, usually insects, although such a statement is surprising in the light of the fact that there have been no detailed and meaningful published studies on natural *Eucalyptus* pollination by insects. Ashton (1975) noted a wide array of insect visitors to *E. regnans* blossoms, including beetles, flies, bees and butterflies, but did not examine pollen loads, insect behaviour etc. Birds such as honeyeaters and brush-tongued parrots are also known to pollinate *Eucalyptus* flowers (e.g. Paton and Ford, 1977), although with most eucalypts, bird pollination is generally regarded as a secondary occurrence with insects as the primary pollinators (Pryor, 1951, 1976). Pryor (1976) notes that results of a study by Cooling and Endean (1966) which found that wind pollination was indeed effective, leads to the suggestion that the *Eucalyptus* flower structure permits insect pollination as well as wind pollination.

Sargent (1928), an earlier worker on Australian Pollination biology, believed that the genus *Eucalyptus* was *exclusively* pollinated by birds Sargent, 1928, p. 186; Parker, 1977. Sargent (1928) and even went to the extreme by stating "The author (Sargent) has found no trace of pollen on the body of any insect visitor of 'gum' blossoms so far examined. As time rolls on evidence is steadily accumulating that birds are the chief, if not the only, efficient pollinators throughout the genus. If this be proved as a fact, it places Honeyeaters in the front rank of economic importance, for the continuance of our natural forests would be dependant upon them. If the eucalypt forests were to perish utterly the birds would merely turn for sustenance to flowers of other plants; but if honey-eating birds became extinct the eucalypts would probably speedily follow them"!

It is most surprising that in the light of the observations presented in this paper on insects on flowers of *Eucalyptus foecunda* and *E. cylindriflora*, that Sargent did not observe insects pollinating any *Eucalyptus* species (especially *E. foecunda*) in Western Australia. In addition, it is surprising that Sargent did not observe any native insects on *Nuytsia floribunda* (Loranthaceae) either (see Hawkeswood, 1981b, for commcnts). It is highly probable that Sargent did not venture into the arid regions of south-west Western Australia to witness the large populations of Buprestidae and Scarabacidae on flowering *Eucalyptus* species, but concentrated his observations in the Perth area where the beetle species listed in Table 1, do not occur or havc been wiped out as a result of habitat destruction by man.

(f) *Eucalyptus* and thc syndrome of cantharophily.

Hawkeswood (1981a) reviewed most of the information on insect pollination vectors of *Eucalyptus* species and noted that *Eucalyptus* (and *Angophora)* flowers possessed all the features of cantharophily. Hawkeswood (1981a) found that beetles (Coleoptera) were the dominant diurnal pollinators of *A. woodsiana* Bail. during December, in thc Burbank area of south-east Queensland, which led support to Faegri and Van der Pijl's (1976) criteria for cantharophily.

According to Faegri and Van der Pijl (1976), plants which possess the syndrome of cantharophily (i.e. beetle pollination), have all (or most) of the following floral features — (a) flowers with no special or definite shape and few visual attractions; they are generally flat, cylindric or shallow, bowl-shaped and easy of access, (b) flowers which are dull, greenish or cream, and have open, easily accessible attractants such as nectar and pollen, (c) flowers with a strong, fruity or aminoid odour, (d) flowers with exposed anthers and stigmas (i.e. above the level of the corolla or perianth) and (e) flowers with an epigynous ovary (i.e. the ovary is situated below the attachment of the stamens, sepals and petals). Such flowers possess a structure considered to be adaptcd for protection against thc biting jaws of beetles while the strong odour appears to be an adaptation for luring the beetles to the flowers (a beetle's eyesight is usually poor for an insect but its olfactory senses are usually well developed).

The flowers of *E. foecunda* and *E. cylindriflora* possess all the features of cantharophily as proposed by Faegri and Van der Pijl (1976). However, this does not necessarily suggest that these species are obligate cantharophiles since other vectors (viz. wind, birds and/or mammals) may also play a role at other times; e.g. at night or early morning, when perhaps beetles are not active. The observations made between Lake King and Peak Charles, do suggest that beetles are the dominant pollination vectors of these eucalypts in the areas and at the times investigated.

(g) Biological notes on the insect species mentioned in this paper

(A) Scarabaeidae

(a) *Diaphonia (Hemichnoodes) mniszechii* (Janson)

Lea (1914, p. 184) noted that this species occurred from the mallee district of north-western Victoria, through southern South Australia "to the coast of Western Australia as far north as Geraldton". Nothing more appears to have been written on the species since Lea, despite it being a common species, especially in south-west Western Australia. As far as the author is aware, this is the first time that the species has been recorded as a pollination vector.

(b) *Metallesthes metallescens* White

Lea (1914, p. 188) noted that "This species is fairly common in many parts of South and Western Australia". Slater and Lindgren (1955, p. 18) record the species from Queen Victoria Spring in the southern desert area of Western Australia. Since then, nothing appears to have been written on its biology.

(B) Buprestidae

(a) *Stigmodera (Themognatha) tibialis* Waterhouse

Carter (1929, p. 291) listed the distribution of this species as South Australia and Western Australia. Slater and Lindgren (1955, p. 18) list it from *Eucalyptus* flowers. Barker and Inns (1976) record an individual of this species as prey for a large robber fly (Asilidae). Little has been recorded on the biology of *S. tibialis* despite it being one of the most common species in south Western Australia.

(b) *S. (T.) mniszechi* Saunders

Carter (1929, p. 290) listed the species but did not state its distribution. It is presently known to occur in the arid mallee regions of south-west Western Australia across to South Australia (Hawkeswood and Peterson, 1979, unpub. data). It is not known whether the species extends into the mallee area of north-west Victoria. Slater and Lindgren (1955) also record it from *Eucalyptus* flowers.

(c) *S. (T). chevrolati* Gehin

Carter (1929, p. 290) listed the species but did not state its distribution. It is known to occur from the arid areas of south-west Western Australia into South Australia (Hawkeswood and Peterson, 1979, unpub. data). Slater and Lindgren (1955) record it on *Eucalyptus* flowers.

(d) *S. (T.) murrayi* Gem. & Har., *S. (T.) brueki* Thomson and *S. (T.) chaleodera* Thomson

Carter (1929, pp. 289-290) listed these three species from Western Australia only. Slater and Lindgren (1955) have recorded them on *Eucalyptus* flowers.

(e) *Stigmodera (Castiarina) mustelamajor* Thomson

Carter (1929, p. 296) records this species from New South Wales, Victoria and South Australia, while Barker (1979, p. 19) extends the distribution to Queensland and Western Australia. Hawkeswood (1980) recorded the species on flowers of *Melaleuca pauperiflora* F. Muell. (Myrtaceae).

(C) Cleridae

(a) *Eleale aulicordes* Gorh.

Western Australian Museum specimens indicate that this species has a widespread distribution in south-west Western Australia, although nothing appears to have been written on its biology.

(D) Scoliidae

(a) *Campsomeris anthracina* Burn.

The author has been unable to find any biological or taxonomic notes on the species.

Acknowledgements

I would like to thank Messrs. A. S. George and R. J. Cranfield (Western Australian Herbarium, Perth) for assistance in plant identifications, Dr. T. F. Houston (Western Australian Museum, Perth) for allowing access to collections of insects in his care, and Dr. N. G. Marchant (Western Australian Herbarium) and Messrs. G. Harold and M. Peterson (Perth) for reading an earlier draft of the manuscript written in March 1980. I would also like to acknowledge the assistance given by Mr S. Wilson (in providing transport, identification of insects etc.) and Miss A. Kreger. The final draft of this paper was written at the Botany Department, James Cook University, Townsville, with the assistance of funds from Research Grant UC-127-M allocated to the author.

REFERENCES

Alderson, J. (1976). Behaviour and larvae of two rose chafer beetles *Eupoecila australasiae* (Don), *Diaphonia dorsalis* (Don) (Coleoptera: Scarabaeidae, Cetoniinae). *Victorian Nat. 93*, 86-91.

Armstrong, J. (1979). Biotic pollination mechanisms in the Australian flora — a review. *N.Z. J. Bot. 17*, 467-508.

Ashton, D. H. (1975). Studies of flowering behaviour in *Eucalyptus regnans* F. Muell. *Aust. J. Bot. 23*, 399-411.

Barker, S. (1979). New species and a catalogue of *Stigmodera (Castiarina)* (Coleoptera: Buprestidae). *Trans. R. Soc. S. Aust. 103*, 1-23.

Barker, S. and Inns, R. (1976). Predation on *Stigmodera (Themognatha) tibialis* by a fly. *West. Aust. Nat. 13*, 147-148.

Britton, E. B. (1970). Coleoptera. Chapter 30. In: *Insects of Australia*. (Melb. Uni. Press, Carlton, Victoria).

Carter, H. J. (1929). A check list of the Australian Buprestidae. *Aust. Zool 5*, 265-304.

Carter, H. J. (1933). *Gulliver in the Bush*. (Angus and Robertson, Sydney).

Chippendale, G. M. (1973). *Eucalypts of the Western Australian goldfields*. (Department of Primary Industry and Australian Government Publishing Service, Canberra).

Cooling, E. N. and Endean, F. (1966). Forest Development, Zambia. *Forest Research Bulletin, 10*. (Not seen; cited from Pryor, 1976).

Faegri, K. and Van der Pijl, L. (1976). *Principles of Pollination Ecology*. (Permagon Press, London).

Froggatt, W. W. (1907). *Australian Insects*. (W. Brooks and Co., Sydney).

Hawkeswood, T. J. (1978). Observations on some Buprestidae (Coleoptera) from the Blue Mountains, N.S.W. *Aust. Zool. 19*, 257-275.

Hawkeswood, T. J. (1980). Jewel beetles as pollinators of *Melaleuca pauperiflora* F. Muell. between Eucla (W.A.) and Koonalda (S.A.) *West. Aust. Nat. 14*, 238-239.

Hawkeswood, T. J. (1981a). Insect pollination of *Angophora woodsiana* F. M. Bail. (Myrtaceae) at Burbank, south-east Queensland. *Victorian Nat. 98*, 120-129.

Hawkeswood, T. J. (1981b). Notes on the pollination of *Nuytsia floribunda* (Labill.) R.Br. (Loranthaceae) and some literature reviewed. *West. Aust. Nat. 15*, 17-21.

Hawkeswood, T. J. (1981c). Observations on two sympatric species of Buprestidae (Coleoptera) from sand dunes on the north coast of New South Wales. *Victorian Nat. 98*, 146-151.

Hawkeswood, T. J. (1981d). Observations on some jewel beetles (Coleoptera: Buprestidae) from the Armidale district, north-eastern New South Wales. *Victorian Nat. 98*, 152-155.

Lea, A. M. (1914). Notes on Australian Cetonides; with a list of species and descriptions of some new ones. *Trans. Roy. Soc. S. Aust. 38*, 132-218, + plates VI-XIII.

McKeown, K. C. (1945). *Australian Insects*. (Royal Zoological Society of New South Wales, Sydney).

McMillan. R. P. (1952). Western Australian *Stigmodera*. *West. Aust. Nat. 3*, 145-147, + plate.

Parker, S.A. (1977). Birds as pollinators. *Aust. Bird Watcher 7*, 124-133.

Paton, D. C. and Ford H. A. (1977). Pollination by birds of native plants in South Australia. *Emu 77*, 73-85.

Pryor, L. D. (1951). Controlled pollination of *Eucalyptus*. *Proc. Linn. Soc. N.S.W. 77*, 361-363.

Pryor, L. D. (1976). *Biology of Eucalypts*. (Institute of Biology's Studies in Biology No. 61, Edward Arnold, London).

Pryor, L. D., Chattaway, M. M. and Kloot, H. N. (1956). The inheritance of wood and bark characters in *Eucalyptus*. *Aust. J. Bot. 4*, 216-238.

Sargent, O. H. (1928). Reactions between birds and plants. *Emu 27*, 185-192.

Slater, P. and Lindgren, E. (1955). A visit to Queen Victoria Spring, January, 1955. *West. Aust. Nat. 5*, 10-18.

Williams, G. A. (1977). A list of the Buprestidae (Coleoptera) collected from *Leptospermum flavescens* Sm. at East Minto, New South Wales. *Aust. ent. Mag. 3*, 81-82.

Field Naturalists Club of Victoria

Reports of recent Club activities

General Meeting
Monday 14 December

New FNCV Secretary. President Miss Clark announced the appointment of Mr Dave Lee as Club Secretary. Dave brings with him great know-how and experience for he was secretary some 10-15 years ago but had to retire due to health reasons. We welcome him back to his old job.

Group in recess. At the meeting on Monday 7 December, members of the Entomology and Marine Biology Group decided that the Group should go into recess. Only about seven or eight attend each meeting and there are other specialist societies which members could join if they wish.

Hawthorn Juniors. The programme was provided by members of Hawthorn Junior FNC; their chairman, Mr Malcolm Turner, introduced each speaker and subject in turn.

Axolotl. Andrew Pilskans (age about 13) told us about the axolotyl, the larva of a salamander from the lakes of Mexico, that breeds when still in the larval form.

Orchids. With the aid of a large white exotic orchid, Tom Long (age about 10) showed the parts of an orchid. He spoke of the specialist adaptation for pollination by insects and said that Australia has more than 400 species.

Blue-tongue Lizards. Brian Glassenbury (age about 15) said that Bluetongues can grow to more than 50cm